EFFECT OF WEIGHT LOSS ON THE DECREASE OF LENGTH OF COASTAL CUTTHROAT TROUT

T. E. NICKELSON and G. L. LARSON

Department of Fisheries and Wildlife
Oregon State University, Corvallis, Oregon

DURING A STUDY OF POPULATION DYNAMICS of the coastal cutthroat trout (*Salmo clarki*) in Berry Creek, Oregon, many of the fish in the population [1] exhibited weight loss and decreases in fork length during periods when food abundance in the stream was low. The decreases in fork length ranged from about 1 to 3 percent from August to November, and in individual cases was over 2 percent in a single month.

Variations in the length-weight relationship of fishes could have important consequences in the interpretation of the meaning of condition factors, and also, estimates of body weights from body lengths. Because the phenomenon of length decreases in fishes has not been described before, to our knowledge, we performed an experiment to determine if our observations of decreased body length of Berry Creek cutthroat trout were accurate, or errors in measurement.

METHODS

Twenty-five wild yearling coastal cutthroat trout (mean fork length of 100.6 millimeters) were collected from Oak Creek, a small woodland stream near Corvallis, Oreg. The fish were randomly divided into five groups of five fish each and kept separately in five 70-liter aquariums supplied with filtered stream water located at the Pacific Cooperative Water Pollution Laboratory, Corvallis, Oreg. Each fish was identified by a fin clip. All fish were then starved for 7 weeks. Water temperatures were recorded with a thermograph.

The fish were anesthetized with MS-222 (tricane methyl sulfonate) before handling. Fork lengths and body weights were measured to the nearest 0.5 millimeter and 0.01 gram respectively, at the beginning of the starvation period and then again after 2, 4, and 7 weeks. To determine the accuracy of our measurements of body length, we measured three fish at random 20 times each. Little variation was found among the data (S = 0.11 millimeter in each case).

A chi-square 2 × 2 contingency table [6] was used to test if statistically significant numbers of fish had decreased in fork length during the starvation periods.

RESULTS AND DISCUSSION

The results of this experiment apparently confirm the field data collected at Berry Creek that weight loss of coastal cutthroat trout is at times accompanied by loss of length (table 1). The most extensive length loss occurred during the 3d and 4th weeks when water temperatures were highest (table 2); the loss was probably related to increased metabolic rates during the period. Field data from Berry Creek suggested a similar relationship between temperature and rate of length loss [4].

Weight loss can cause a shift in the length-weight relationship of a population of fish, the result being that a fish of a given length weighs less. If however, loss of length accompanies the weight loss, the shift may not be as great, and a fish of a given length weighs more than if no length loss had occurred. In either case changes in the length-weight relationship could contribute serious errors in estimates of biomasses of fish populations if weights are determined

[1] Field data from Berry Creek were collected monthly from August to December 1972 by seining the fish, then weighing and measuring each fish individually. Each fish longer than 80 millimeters was identified by a numbered tag.

Table 1.—Length and weight losses of coastal cutthroat trout which decreased in fork-length during the starvation experiment

Length of starvation (weeks)	Total number of fish *	Number of fish decreasing in fork-length	X^2	Significance $df = 1$, $p = 0.05$	Mean decrease in length mm	Mean decrease in length %	Mean loss of weight grams	Mean loss of weight %
2	21	3	1.44	Not significant	0.67	0.67	0.25	0.73
4	21	13	16.04	Significant	.88	.87	.74	6.46
7	21	15	20.33	Significant	1.23	1.23	1.18	16.12

* Four fish died during the first 2 weeks of the experiment and were not included in the analysis.

Table 2.—Mean water temperature for each starvation period

Starvation period (weeks)	Mean temperature (°C)
1-2	1.4
3-4	7.3
5-7	5.7

from body lengths using a previously determined length-weight relationship. The length-weight relationship should be determined as frequently as possible to minimize the occurrence of such errors.

Condition factors have been used as indicators of general well-being of fishes [*1, 2, 3, 5*]. In addition to influences from age, sex, and length, it appears that losses of body length in fishes could seriously affect the significance of the meaning of condition factors by overestimating the well-being of animals if the accompanying changes of body weight alter the length-weight relationship.

ACKNOWLEDGMENTS

We thank Messrs. E. Wilson, L. Lamperti, and R. Aho for helping us collect the fish. Drs. G. Davis, R. Dimick, and L. Weber read the manuscript and offered suggestions. Their comments were appreciated.

REFERENCES

1. HILE, RALPH.
1936. Age and growth of the cisco *Leucichthys artedi* (LeSueur) in the lakes of the northeastern highlands, Wisconsin. Bulletin of the U.S. Bureau of Fisheries, vol. 48 (1935), p. 211-317.
2. KLAK, G. E.
1940. The condition of brook trout and rainbow trout from four eastern streams. Transactions of the American Fisheries Society, vol. 70, p. 282-289.
3. LAGLER, K. F.
1956. Freshwater fishery biology, 2d edition. Wm. C. Brown Co., Dubuque, Iowa. 431 p.
4. NICKELSON, T. E.
In preparation. Population dynamics of the coastal cutthroat trout in a small woodland stream. Master's thesis, Oregon State University, Corvallis.
5. ROUNSEFELL, G. A., and W. H. EVERHART.
1953. Fishery science, its methods and applications. J. Wiley & Sons, New York. 444 p.
6. SIEGEL, S.
1956. Nonparametric statistics, for the behavioral sciences. McGraw-Hill Co., New York. 312 p.